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(54) Liquid level monitoring means

(57) Liquid level monitoring means comprises a sensor (1), which can be used in, for example, propellant fuel filter or in oil-water separator of a heating installation, and a switching device (5, 6, 7) which reduces or switches off a signal current flow through the sensor (1) as soon as the level of the liquid being monitored, for example water in filter, has reached the sensor tip. As a result, excessive corrosion of the sensor tip is prevented, so that the life of the sensor is prolonged. A lamp or luminescent diode 8 provides a continuous alarm indication.

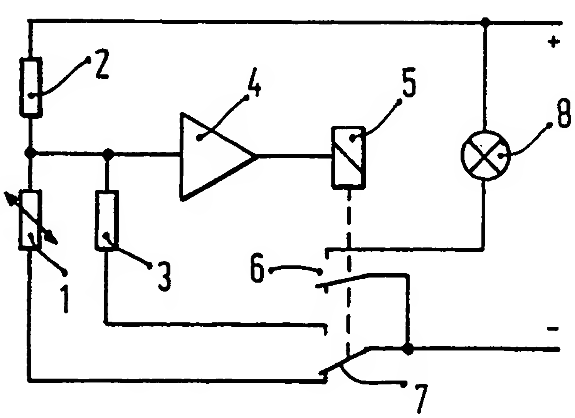

Fig. 1

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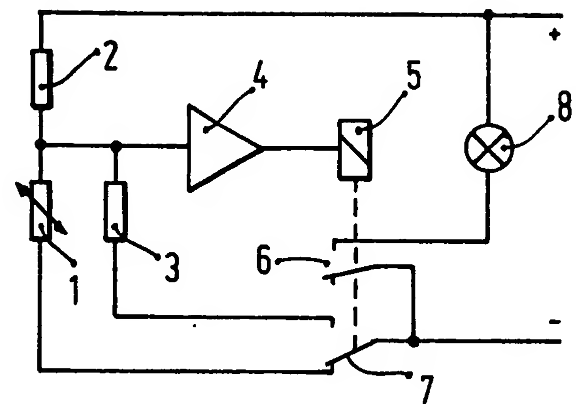

Fig. 1

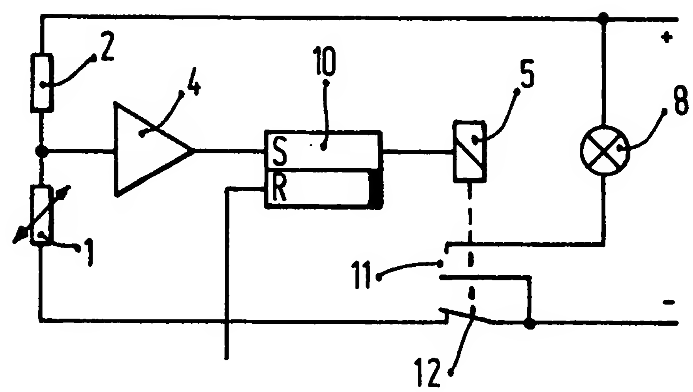

Fig. 2

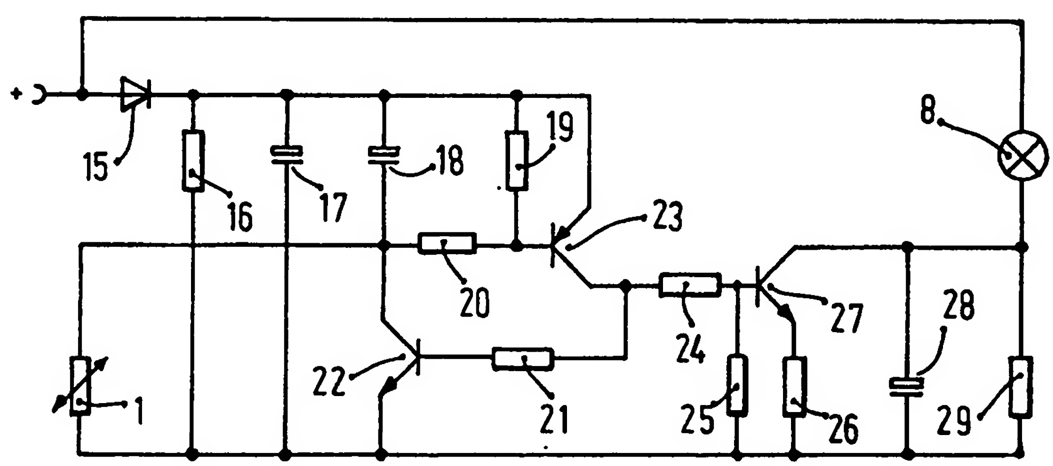

Fig. 3

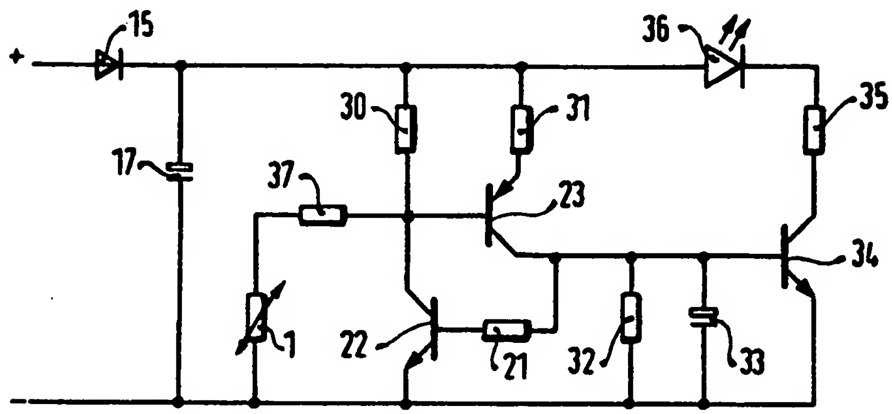

Fig. 4

SPECIFICATION
Liquid level monitoring means

The present invention relates to liquid level monitoring means, for example a water-indicating device for a fuel-water separator, such as a fuel filter.

A propellant fuel filter, at the bottom of which is installed a sensor, is disclosed in US—PS 4 276 161. The known device comprises an alarm which responds as soon as the water level in the filter exceeds a predetermined value. The user of the filter is thus informed that the water has now to be let off. However, the known device has the dis-advantage that the delivery of the alarm signal requires a strong current through the sensor. As a result, a substantial degree of corrosion occurs at the sensor tip, which makes the sensor unusable within a short time. If the water is not let off, the sensor has to be renewed. A further disadvantage is that the corrosion products from the sensor get into the fuel and can cause, for example, damage in an injection pump.

According to the present invention there is provided liquid level monitoring means comprising a level sensor for conducting a current so as to deliver a signal in response to a predetermined level of liquid being exceeded, indicating means responsive to such signal to provide an indication, and control means to at least reduce the flow of current through the sensor after delivery of the signal.

Level monitoring means embodying the present invention may have the advantage that the life of the sensor is prolonged, since corrosion cannot occur. It is to be regarded as a further advantage that damage to associated units, due to sensor corrosion, may be avoided.

It is particularly advantageous to maintain the indication by means of a storage member after switching-off the sensor. Through this measure, the current consumption of the circuit is minimal. It may also be expedient to provide a resistor, the value of which corresponds to the sensor in a signal-delivering state and to conduct the current through this resistor on the responding of the sensor. Through this measure, too, a storage behaviour is attained. This circuit is particularly simple, since only switching-on or switching-off contacts is required, so that transistor switches can be used.

Another possibility is to reduce the current through the sensor after the signal delivery. This makes possible a particularly simple circuit arrangement. A further advantage is that the sensor remains capable of functioning to a restricted extent. It may be expedient in this case to connect a transistor, which is switched to become conducting on signal delivery by the sensor, in parallel with the sensor. The conductivity of the transistor may be variable within wide ranges, so that the circuit is easily adapted to different sensors.

Embodiments of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a circuit diagram of first level monitoring means embodying the invention;

Fig. 2 is a circuit diagram of second level monitoring means embodying the invention;

Fig. 3 is a circuit diagram of third level monitoring means embodying the invention; and

Fig. 4 is a circuit diagram of fourth level monitoring means embodying the invention.

Referring now to the drawings, there is shown in Fig. 1 a sensor in the form of a variable resistor 1. One terminal of the sensor 1 is connected with the input of an amplifier 4 and the other terminal of the sensor 1 with one contact of a change-over switch 7. Connected to one input of the amplifier 4 is a further resistor 2, which on the other hand is connected with a positive supply voltage line. A resistor 3 is connected between a further contact of the switch 7 and the input of the amplifier 4. A centre contact of the switch is connected with a negative supply voltage line. A relay 5 is switched by the output of the amplifier 4. The relay 5 switches the contact 7 and a switching contact 6. Connected to the positive supply voltage line is a lamp 8, which in turn is connected to the contact 6. The other pole of the contact 6 leads to the common ground line.

The function of the above circuit will be explained for a vehicle fuel filter with sensor. When the vehicle is started, a voltage of, for example 3.4 volts is present at the sensor 1. if there is no water in the filter, no sensor current flows and the relay 5 is off. This state is illustrated in Fig. 1. The lamp 8 does not light up.

When water is disposed in the sensor, a current flows through the sensor 1 by reason of the conductivity. The voltage at the input of the amplifier 5 collapses and the relay 5 attracts. As a result, the switching contacts 6 and 7 are actuated. The lamp 8 is connected with the ground line through the contact 6 so that the lamp lights up. The current through the sensor 1 is interrupted through the contact 7 and, instead thereof, the resistor 3 is connected to the negative supply voltage line. As a result, the sensor current flow is simulated by the current flow through the resistor 3. The resistor 3 must therefore have the value which the sensor assumes in the conducting state. The relay 5 remains attracted and the lamp 8 continues to light up even when the sensor current is interrupted.

When the engine of the vehicle is turned off, the contacts 6 and 7 return to the initial setting. On restarting of the vehicle, the voltage is again present at the sensor 1. If the water has not yet been let off, then the afore-described process devolves. The circuit has the advantage that the sensor is loaded only quite briefly when water is disposed on the filter. Through this measure, the sensor does not require to be exchanged regularly and maintenance is greatly reduced.

Fig. 2 shows a further embodiment of the invention. The sensor 1, which is illustrated in the circuit diagram as variable resistor, is again

connected on the one hand with the input of the amplifier 4 and on the other hand with an operating contact 12. A resistor 2 is also connected with the input of an amplifier 4 and with a positive supply voltage line. The output of the amplifier 4 is connected with the setting input of a storage member 10, which in the illustrated embodiment is constructed as an RS-flip-flop. The resetting input of the member 10 is, for example, connected with a signal line for the vehicle ignition. The output of the member 10 leads to a relay 5, by which the contacts 11 and 12 are switched. Also connected to the positive supply voltage line is a lamp 8, which is connectible through a rest contact 11 with a negative supply voltage. The further terminal of the contact 12 is also connected with the negative supply voltage.

If water is disposed in the filter, then a current again flows through the sensor 1, which switches the amplifier 4. Thereby, the member 10 is set. The relay 5 responds and closes the contact 11 and opens the contact 12. Through the closing of the contact 11, the lamp 8 lights up, which signals to the driver that water must be let off from the filter. The current through the sensor 1 is interrupted through the opening of the contact 12. The resetting input is actuated, for example, on the starting of the engine and thus it is connected to an ignition voltage line. After the setting of the member 10, a continuous indication is provided by the indicating lamp 8 even when the current through the sensor 1 is already interrupted. The contacts 11 and 12 are simple switches so that they can be constructed as transistor switches. In this case, the output signal of the member 10 is directly usable for the driving of the transistor switch for the contact 11 and through an inverting member for driving the transistor switch for the contact 12.

In Fig. 3, the water sensor is again designated by 1. The sensor is connected on the one hand with a negative supply line and on the other hand with the collector of a transistor 22 and one terminal of a resistor 20. A positive supply voltage line leads to a lamp 8 and to the anode of a diode 15. The cathode of the diode 15 is connected through a parallel connection of a resistor 16 and a capacitor 17 with the negative supply voltage line, and also connected by a capacitor 18 to the collector of the transistor 22. The emitter of the transistor 22 is connected to the negative supply voltage line. The other terminal of the resistor 20 is connected to the base of a transistor 23 and through a resistor 19 to the cathode of the diode 15. The emitter of the transistor 23 is also connected to the cathode of the diode 15. The collector of the transistor 23 is connected through a resistor 21 with the base of the transistor 22. Also connected to the collector of the transistor 23 is a resistor 24, which in turn is connected to the base of a transistor 27. From the base of the transistor 27, a resistor 25 is connected to the negative supply voltage line. The emitter of the transistor 27 is connected through a resistor 26 with the negative supply voltage line. The lamp 8 as well as the parallel connection of a capacitor 28 and a resistor 29 are connected to the collector of the transistor 27. The capacitor 28 and the resistor 29 are connected at the other side to the negative supply voltage line.

In this circuit, the transistors 22, 23 and 27 are blocked in the normal state, i.e. when the water level has not yet reached the sensor. The lamp 8 does not light up. If the water now rises in the filter and touches the sensor, then a current flows through this. As a result, the base of the transistor 23 receives a negative potential and switches through. The transistor 17 is also switched so that the lamp 8 lights up. At the same time, transistor 22 is switched through, the collector-emitter path of which is in parallel with the sensor 1 and thus relieves the sensor 1 in the switched-through state of the transistor 22. The substantial proportion of the original sensor current now flows through the collector-emitter path of the transistor 22. The sensor itself continues to conduct only a very small current, which is determined mainly by the voltage drop at the collector-emitter path of the transistor 22. Through this measure, too, a longer life of the sensor can be achieved, since the material removal through electrolysis is very small for the small current still flowing. On the other hand, the initial current through the sensor 1 can be chosen to be very large so that the circuit responds reliably.

A particularly simple circuit for indication of the water level is illustrated in Fig. 4. Connected to a positive supply voltage terminal is a diode 15 and a capacitor 17, the latter also being connected to a negative voltage supply terminal. The sensor 1 is connected on the one hand with the negative supply line and on the other hand through a resistor 37 with the collector of a transistor 22. The emitter of the transistor 22 is connected to the negative supply voltage line. The collector of the transistor 22 is also connected through a resistor 30 with the diode 15 and with the base of a transistor 23. The base of the transistor 22 is connected through a resistor 21 with the collector of the transistor 23. The emitter of the transistor 23 is connected through a resistor 31 with the diode 15. The collector of the transistor 23 leads to the base of a transistor 34. In addition, a parallel connection of a resistor 32 and a capacitor 33 is connected to the negative supply voltage line. The emitter of the transistor 34 is connected with the negative supply voltage line, while the collector of the transistor 34 is connected through the series connection of a resistor 35 and a luminescent diode 36 with the diode 15. With appropriate dimensioning of the resistor 35, an incandescent lamp can be used in place of the luminescent diode 36.

The manner of operation of this circuit corresponds to that of the circuit of Fig. 3. In the normal state, i.e. when the water level has not yet reached the sensor 1, the transistors 22, 23 and 34 are blocked. The luminescent diode 36 does not light up. When the water rises and touches the sensor 1, then a current flows through this. As a

result, the base of transistor 23 receives negative potential and this transistor is switched through. This now switches transistor 34 through and the lamp lights up. At the same time, the transistor 22 is switched through, the collector-emitter path of which is in parallel with the sensor 1 and thus relieves the sensor 1 in the switched-through state of the transistor 22. This circuit has the advantage that it is insensitive to wrong connections and needs only few components.

The described and illustrated circuits are eminently suitable for the indication of a maximum water level in petrol and diesel fuel-water separators. The circuits are not restricted to use in vehicles, for example they are usable in oil separators, such as in heating installations.

CLAIMS

1. Liquid level monitoring means comprising a level sensor for conducting a current so as to deliver a signal in response to a predetermined level of liquid being exceeded, indicating means responsive to such signal to provide an indication, and control means to at least reduce the flow of current through the sensor after delivery of the signal.

2. Monitoring means as claimed in claim 1, the control means being adapted to interrupt the flow of current through the sensor after delivery of the signal.

3. Monitoring means as claimed in claim 2, comprising storage means to cause the indication means to continue to provide the indication after current flow through the sensor has been interrupted.

4. Monitoring means as claimed in claim 2, comprising a resistor which has a resistance substantially equal to that of the sensor when conducting the current and which is arranged to conduct the current in place of the sensor when the current flow through the sensor is interrupted.

5. Monitoring means as claimed in claim 1, comprising a transistor which is connected in parallel with the sensor and which is switched to be conductive on delivery of the signal.

6. Monitoring means as claimed in any one of the preceding claims in combination with a fuel filter, the monitoring means being adapted to monitor the level of a liquid filtered from fuel by the filter.

7. Liquid level monitoring means substantially as hereinbefore described with reference to any one of Figs, 1 to 4 of the accompanying drawings

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